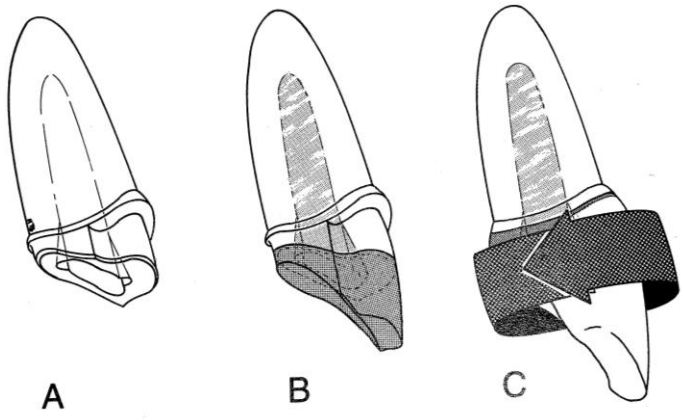
227. Which of the following statements describes the ferrule effect?

A. Blending proximal axial reduction with buccal and lingual axial reductions
B. Maintaining a consistent cervical height for the finish line of a full-coverage preparation
C. Adding anti-rotational features to an endodontically treated tooth's cast post and core
D. Preparing the crown margin on a tooth 1.0-2.0 mm apical to the margin of a core restoration

Answer: D.

- The ferrule effect is important when restoring endodontically treated teeth with fixed prosthodontic restorations
- A band of natural tooth, known as a ferrule, is created when the endodontically treated tooth's completed crown preparation extends below the margin of the core buildup material
- it is most preferable when the extension is 1.0 – 2.0 mm
- The ferrule effect ***strengthens*** the weakened endodontically treated tooth and ensures that occlusal forces are redistributed to the natural tooth rather than its restored core
- To create the ferrule effect in extensively damaged teeth, a periodontal crown-lengthening procedure often is necessary to access the natural tooth margin
- Buccal/lingual reduction should be blended smoothly in the full-coverage preparation and consistent vertical finish line heights do enhance esthetics; neither is related to the ferrule effects.



If a tooth is flush with the gingival (A), fabrication of a post, core and crown without encirclement of the tooth structure by the crown walls could lead to root fracture (C)

Shillingburg HT. Fundamentals of Fixed Prosthodontics, 3rd Ed. Quintessence Publishing Co. 1997:191-196.

228. Centric relation is

a. A tooth to tooth relationship in which the condylar complex is in the anterior superior position
b. A jaw to jaw relationship in which the condylar complex is in the posterior superior position
c. A jaw to jaw relationship in which the condylar complex is in the anterior superior position
d. A tooth to tooth relationship in which the condylar complex is in the posterior superior position

Answer C.

Centric relation is a jaw to jaw relationship in which the condyles articulate with the thinnest avascular portion of their respective discs with the complex in the anterior superior position against the slopes of the articular emenences, regardless of any tooth-to-tooth relationship. This position is clinically discernable when the mandible is directed superiorly and anteriorly and restricted to a purely rotary movement about a transverse horizontal axis.

In centric relation, the condyle-disc assemblies are braced medially. Thus, centric relation is also the midmost position of the mandible. If a healthy joint is correctly positioned and aligned in centric relation, it can resist maximum loading in function with no sign of tension or tenderness.

Dawson, Peter E.. Evaluation, Diagnosis and Treatment of Occlusal Problems, 2nd Edition. *C.V. Mosby, 1988.*

Okesson

229. The best technique for recording Centric Relation will _____?

A. push the condyles down and back
B. have bilateral tooth contact when done properly
C. always have pain in the TMJ when loaded
D. align the condyle-disk assemblies in the most superior position

ANSWER: D. align the condyle-disk assemblies in the most superior position

There is no one specific way that must be used to record centric relation correctly, but there are important similarities that are common in all the techniques that consistently achieve it.
Centric relation may be defined as the relationship of the mandible to the maxilla when the properly aligned condyle-disk assemblies are in the most superior position against the eminentia, irrespective of tooth position or vertical dimension.
Centric occlusion refers to the relationship of the mandible to the maxilla when the teeth are in maximum occlusal contact, irrespective of the position or alignment of the condyle-disk assemblies. This is also referred to as the ***acquired position*** of the mandible or the ***maximum interocclusal position*** **(MIOP).**

1. One-handed techniques almost never achieve correct centric relation positioning. Chin-point guidance tends to push condyles down and back.

2. The mandible cannot be *forced* into centric relation. The uppermost terminal axis must be *delicately* located in an open position *without pressure* on the mandible, and *then* it must be firmly held on that axis while the jaw is closed to the first point of contact. Pressure applied before the joints are in centric relation activates muscle contraction.

3. It is difficult to record centric relation when the patient is upright. Manipulation of the mandible is simpler and far more consistent if the patient is supine.

4. If upward pressure toward the condyles causes any sign of discomfort or tension, the position cannot be accepted as centric relation. A differential diagnosis must be made to determine the cause of the discomfort before one proceeds.

5. The most commonly found cause for discomfort from upward pressure is related to tension of hypercontracted muscle. Muscle spasm can affect both the position of the condyle and the alignment of the disk. In most instances, delicate manipulative techniques can be used to release the spasm and ease the condyles into the correct position.

6. Once a correct method of manipulation is learned, patients will not resist the operator. Drugs, injections, or appliances are rarely needed if the mandible is manipulated properly. This is true even in patients with acute trismus in all but the rarest cases unless an intra-articular problem is present.

Dawson, Peter E.. Evaluation, Diagnosis and Treatment of Occlusal Problems, 2nd Edition. *C.V. Mosby, 1988.*

230. All of the following are reasons to perform a chairside remount for a major fixed prosthodontic case except

A. Tooth movement occurs from the time the working cast impressions are made to the time that the restorations are seated on the teeth
B. Can compensate for errors during fabrication
C. There can be errors in detail transfers between the impression and final castings
D. Intraoral occlusal adjustment is less reliable than on the articulator

Answer: D. Intraoral is less reliable than on the articulator

There are six transfers in the fabrication of a cast restoration: tooth to impression, impression to die, die to wax, wax to investment, investment to metal, metal to tooth. Errors may occur at any of these transfers. There are many opportunities for error and too many variables from the time of the impression to the time of cementation of the restoration. A remount procedure can compensate for these errors.

Since teeth are retained in the alveolar bone as a result of the forces upon them, their positions change whenever those forces vary. Provisional restorations often have different dimensions both on the axial and occlusal surfaces which alter the forces upon the teeth and reposition them.

Eggleston DW. Advantages and use of the remount for fixed prosthodontics. J Prosthet Dent 1980; 43(3):627-33.

231. Ante's law is useful for determining the prognosis of fixed dental prosthesis. The definition is: The combined pericemental area of all abutment teeth should be _____.

A. always greater in pericemental area than the tooth or teeth to be replaced
B. less than the pericemental area than the tooth or teeth to be replaced
C. equal to or greater in periapical area than the tooth or teeth to be replaced.
D. equal to or greater in pericemental area than the tooth or teeth to be replaced.

ANSWER: D

Ante's Law (Irwin H: Ante, Toronto, Ontario Canada. Dentist): *eponym*, in fixed partial prosthodontics for the observation that the combined pericemental area of all abutment teeth supporting a fixed dental prosthesis should be equal to or greater in pericemental area than the tooth or teeth to be replaced; as formulated for removable dental prosthododontics, the combined pericemental area of the abutment teeth plus the mucosa area of the denture base should be equal to or greater than the pericemental are of the missing teeth.

Ante IH. The fundamental principles, design and construction of crown and bridge prosthesis. Dent Item Int 1928:50:215-32

232. Which is the hardest alteration to achieve?

a. Increase in hue
b. Decreasing chroma
c. Decreasing hue
d. Decrease in value

ANSWER b. Decreasing chroma

Increasing the chroma (saturation) is one of the simplest shade alterations to achieve. The addition of yellow stain increases the chroma of a basically yellow shade, whereas orange has the same effect on a yellow-red shade.
When an alteration in hue is required, pink-purple moves yellow toward yellow red, whereas yellow decreases the red content of a yellow-red shade. These are the only two modifications that should be necessary, because the hue of a natural tooth always lies in the yellow-red to yellow orange.
A metal ceramic restoration that has too high a chroma is difficult to modify. Choosing a shade with a lower chroma is always better because a lower chroma can be altered easily. Using the complementary color of a restoration reduces its chroma. Yellow requires purple-blue and orange requires blue or blue-green.
Value can be reduced by adding a complementary color. Violet is used on yellow. Attempting to increase value is less successful because opacity will always be increased as well.

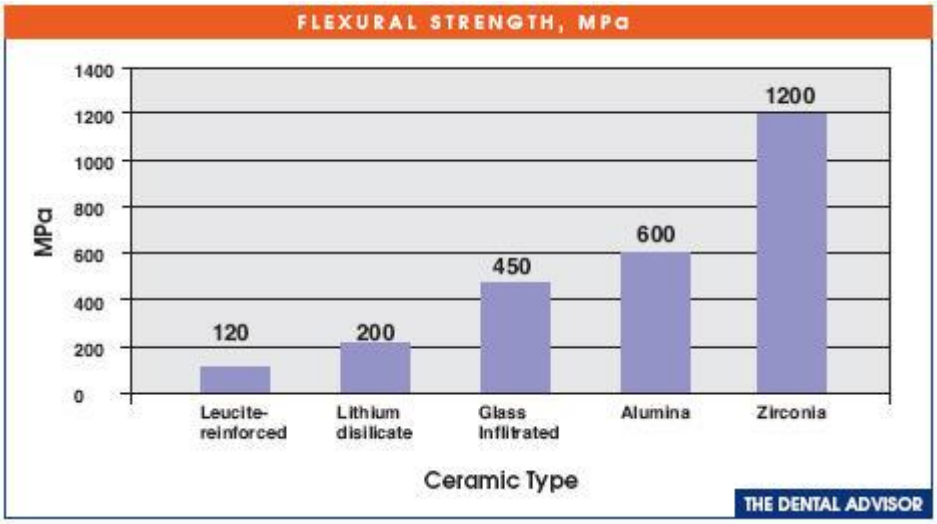
Rosenstiel et al, Contemporary Fixed Prosthodontics; 4th edition

233. Which of the following dental ceramics exhibit the highest flexural strength?

A. Alumina-based crystalline-reinforced materials
B. Silica-based crystalline-reinforced materials
C. Conventional feldspathic
D. Glass-reinforced materials

Answer: A. Alumina-based crystalline-reinforced materials

- Flexural strength of 6 dental ceramic materials was measured using a three-point-bend test
- Conventional feldspathic porcelain and soda-lime glass were used as controls
- All 6 materials had significantly greater breaking strength than the controls
- Alumina-based crystalline-reinforced materials exhibited *the highest breaking strengths*
- Silica-based crystalline-reinforced materials resulted in ceramic materials with more moderate strength but still with significantly greater strength than the controls
- Scanning electron microscopic analysis of the fractured surfaces indicated crack deflection appeared to be the principal strengthening mechanism in the highly crystalline materials.



Seghi RR, Sorensen JA. Relative flexural strength of six new ceramic materials, J. Esthet Restor Dent. 2002;14(3):188-911

234. The purpose of silane treatment of porcelain is to

a. Decrease the wettability of the porcelain surface and increase the contact angle
b. Increase the wettability of the porcelain surface and increase the contact angle
c. Increase the wettability of the porcelain surface and provide a chemical link
d. Increase the wettability of the porcelain surface and provide a mechanical link

Answer: C

Silane treatment of porcelain

Etched porcelain-bonded restorations have become the treatment of choice for the esthetic restoration of anterior teeth. The bond strength of composite resin to properly etched and silanated porcelain exceeds the cohesive strength of porcelain. Although bonding to enamel is accomplished by only etching the surface to create micromechanical retention, **bonding to porcelain is achieved both mechanically through etching porcelain and chemically through the use of a silane coupling agent. Literature supports silanization of porcelain, which provides a more reliable bond than etching with hydrofluoric acid only**, although the combination of both are recommended. This article discusses the importance of proper silanization of porcelain in obtaining a durable and reliable resin composite bond with porcelain

Barghi N. To silanate or not to silanate: making a clinical decision. Compend Contin Educ Dent. 2000 Aug;21(8):659-62, 664; quiz 666.

Porcelain Bonding Surface Techniques

Since glazed porcelain surfaces are not amenable to resin penetration , mechanical or chemical pre-treatment of the surface is essential for successful direct bonding. **Use of silanes (gamma-methacryloxypropyl-trimethoxy silane) which provide a chemical link between porcelain**
and composite resin and increase the wettability of the porcelain surface. In the present study, the highest SBS (surface bond strength) were obtained with HFA and silane application. This is an expected result as HFA facilitates micromechanical retention and silane provides a chemical link between porcelain and composite resin

Conclusions

1. Surface treatment with HFA and a silane coupling agent produced the highest bond strength.
2. Sandblasting before HFA and silane application did not significantly increase bond strengths.
3. Silane application to sandblasted porcelain provided poor results *in vitro* and clinical trials are needed to determine its reliability for bonding ceramic brackets to ceramic crowns.

Türkkahraman H. Küçüke HC. Porcelain surface-conditioning techniques and the shear bond strength of ceramic bracket. European Journal of Orthodontics 28 (2006) 440–443

Overview of bonding systems

Optimization of tooth surfaces involves the use of acids for the removal of smear debris and the dissolution of apatite crystals from enamel and dentin to develop microporous surfaces. Acid treatment also modifies the surface energy, which can be easily observed by placing a drop of water on either enamel or dentin before and after acid treatment. In the "before" case, the drop of water is observed to "bead-up" and have a relatively large contact angle. After acid treatment, the water spreads on the surface and has a contact angle that is effectively as low as zero. **In general, primers are bi-or multifunctional molecules with chemical group termination that treat with the adherends. In dental applications, primer molecules have an "adhesive" group on one end to react with enamel or dentin and a polymerizable group at the other end to cross-link with resin overlayers, typically known as "bonding" or "adhesive" resins**. Variations of phosphorous-containing functionalities have been the most common feature of adhesive groups, although other functionalities, such as carboxylic acids have been shown to be useful. **The adhesive and polymerizable ends of the primer are separated by a "spacer," which determines many of the properties of the primer, including solubility and wetting**

The function of a primer when bonding to enamel is to wet the surface and penetrate microporosities. In dentin, in addition to wetting, primers diffuse through the surface of the demineralized region and entangle collagen fibers on polymerization. Primers also can react with functional groups inherent to collagen or with apatite inherent to enamel or at the front between unaltered and demineralized dentin.

Stangel, I, Ellis TH, Sacher D., Contemporary bonding systems. Dent Clin N Am 51 (2007) 677-694

235. What is an acceptable and realistic film thickness of a luting cement

A. 0.5 µ
B. 1 µ
C. 25 µ
D. 200 µ

ANSWER: C. 25 µ

Film thickness also refers to the thickness of the cement between a cast crown, inlay, onlay, or veneer and the tooth structure. As discussed in the previous section, the thickness of this film plays a significant role in the retention of the prosthesis. This film thickness varies with (1) the amount of force applied during seating of a prosthesis, (2) the manner in which the force is applied to the prosthesis during seating, (3) the configuration of the prosthesis relative to its hindering or facilitating the flow of cement, and (4) the fit of the prosthesis on the prepared tooth. The film thickness values reported in the literature typically range between 25 and 150 µm.

Cement type	Setting time (min)	Film thickness (µm)	24-hr Compressive strength (MPa)	24-hr Diametral tensile strength (MPa)	Elastic modulus (GPa)	Solubility in water (wt%)	Pulp response
ANSI/ADA Specification 8 (Type I)	5.0 (minimum)	25 (maximum)	69	N/A	N/A	0.20 (maximum)	See note*
Zinc phosphate	5.5	20	104	5.5	13.5	0.06	Moderate
ZOE (Type I)	4.0-10	25	6-28	—	—	0.04	Mild
ZOE-EBA (Type II)	9.5	25	55	4.1	5.0	0.05	Mild
ZOE plus polymer (Type II)	6.0-10	32	48	4.1	2.5	0.08	Mild
Silicophosphate	3.5-4.0	25	145	7.6	—	0.40	Moderate
Resin	2.0-4.0	<25	70-172	—	2.1-3.1	0-0.01	Moderate
Polycarboxylate	6.0	21	55	6.2	5.1	0.06	Mild
Glass Ionomer	7.0	24	86	6.2	7.3	1.25	Mild to moderate

*Note: Based on comparison with silicate cement, a severe irritant.

Table 16-3 Properties of Dental Cements Used for Bonding Applications

Anusavice, Kenneth J.. Phillips' Science of Dental Materials, 11th Edition. W.B. Saunders Company, 2003

236. All of the following are true for Tin plating the intaglio surface of a metal restoration except:

A. removes debris and permits more accurate seating and marginal adaptation of the crowns
B. Silver plating after air abrasion results in formation of tiny crystals, providing micromechanical retention to luting cements
C. Tin forms more organic complexes than other metals
D. Bonding to tin-plated crowns is also effectively provided by micromechanical means

Answer: B. Silver plating after air abrasion results in formation of tiny crystals

Adhesive cements have been shown to increase retention when compared to zinc phosphate, glass-ionomer, or conventional resin cements.

Tin plating after air abrasion results in formation of tiny crystals, providing micromechanical retention to the luting cements.

Previous studies have shown that tin forms more organic complexes than other metals, which may increase bond strength with some adhesives.

Bonding to tin-plated crowns is also effectively provided by micromechanical means.

Possible negative consequences of using a tin-plated surface include introduction of a source of corrosion that may reduce long-term clinical performance.

Proposed methods for surface modification methods for achieving adequate bond to dental gold-alloy surfaces proposed in the past were mechanical grinding, heat treatment, immersion in concentrated nitric acid, electroetching, tin plating, and silica coating. Treatment removed debris and permitted more accurate seating and marginal adaptation of the crowns.

Ayed MF, Rosenstiel SF. Preliminary evaluation of tin plating for extracoronal restorations: evaluation of marginal quality and retention. Int J Prosthodont 1998;11:44-48.

237. What is the consequence of overglazing porcelain?

A. porcelain will fracture
B. becomes milky or cloudy in appearance
C. porcelain turns black
D. bubbles appear on the surface

ANSWER: **B.** unnatural shiny appearance

After the porcelain is cleaned and any necessary stains are applied, it is returned to the furnace for the final glaze firing. Usually, the glazing step is very short; when the glazing temperature is reached, a thin glassy film (glaze) is formed by viscous flow on the porcelain surface. Overglazing is to be avoided, because it gives the restoration an unnatural shiny appearance and causes loss of contour and shade modification. Glazing temperatures and times vary with the type and brand of porcelain employed.

Powers, John M.. Restorative Dental Materials, 11th Edition. C.V. Mosby, 2001

Since porcelain loses its ability to form a natural glaze after multiple firings, an applied overglaze may be indicated on large restorations that have required numerous corrections. However, caution must be exercised not to overfire the porcelain. It may return to a more crystalline state and become milky or cloudy in appearance, a condition known as *devitrification*. Devitrification causes a loss of natural appearance, and no surface treatment can revive the porcelain.

Shillingburg, H. Fundamentals of Fixed Prosthodontics, 3rd Edition. Quintessence Publishing (IL), 011997.

238. The following sequence of terms describes the most esthetic pontic design available to use in a highly visible esthetic zone:

a. Conical/completely convex/initial tissue blanching required
b. Ovate pontic/completely convex /pressure free
c. Ovate/completely convex/initial tissue blanching required
d. Conical/mostly convex/pressure free

ANSWER: b. Ovate pontic/completely convex /pressure free

The ovate pontic is the most esthetically appealing pontic design. **Its convex tissue surface resides** in a soft tissue depression or hollow in the residual ridge, which makes it appear that a tooth is literally emerging from the gingiva. Careful treatment planning is necessary for successful results. **Socket preservation techniques** should be performed at the time of extraction to create the tissue recess from which the ovate pontic form will emerge. **For a pre-existing residual ridge, soft tissue surgical augmentation is typically required.**
When an adequate volume of ridge tissue is established, a socket depression is sculpted into the ridge with surgical diamonds or electro surgery. In either case, meticulous attention to the contour of the pontic of the provisional restoration is essential when conditioning and shaping the residual ridge that will receive the definitive prosthesis. **Because the tissue surface of the pontic is convex in all dimensions**, **it is assessable to dental floss**; however, meticulous oral hygiene is necessary to prevent tissue inflammation resulting from the large area of tissue contact. **Pressure-free contact between the pontic and the underlying tissues is indicated to prevent ulceration and inflammation of the soft tissues.** If any blanching of the soft tissues is observed at try-in, the pressure should be identified (PIP paste) and the **pontic recontoured until tissue contact is entirely passive**

Design	Recommended location	Advantages	Disadvantages	Indications
Sanitary hygienic	Posterior Mandible	Good access for hygiene	Poor esthetics	Nonesthetic zones
Saddle ridgelap	Not recommended	Esthetic	Not amenable to hygiene	Not recommended
Conical	Molars w/o esthetics	Good access for hygiene	Poor esthetics	Posterior areas
Modified ridge lap	High esthetic requirement	Good esthetics	Moderately easy to clean	Most areas w/esthetic concern
Ovate	Max #s 5-12	Superior esthetics, negligible food entrapment	Requires surgical preparation	Desire for optimal esthetics/high smile line

Rosenstiel et al. Contemporary Fixed Prosthodontics; 3rd edition

239. Which one of the following crown margin preparations has the most critical fit?

A. Chamfer
B. Shoulder
C. Shoulder with bevel
D. Knife-edge

Answer: B. Shoulder

Knife-edge
- Least amount of tooth reduction
- Mostly used with a bell-shaped tooth (to avoid excessive reduction)
- Usually results in an over-contoured restoration

Chamfer
- Preferred finish line for cast gold restorations
- More conservative than shoulder
- Generates less stress at the cement interface than knife-edge
- Provides for adequate thickness of gold without over-contouring the restoration

Shoulder
- Used where a bulk of material is needed to strengthen the restoration at the margins
- Used for all-ceramic and metal-ceramic restorations
- It is the least conservative and has the most critical fit (because no bevel)

Shoulder with bevel
- Some clinician believe this finish line is easier to detect in an impression
- Allows for burnishability of margins in a casting
- The bevel is recommended for proximal boxes

Summitt et al. Fundamentals of Operative Dentistry; A Contemporary Approach. third edition, 2006.

240. Which of the following correctly lists the order of accuracy from least to most of an impression material in a wet environment?

a. condensation silicones <polyethers < polysulfides <addition silicones
b. polysulfides < polyethers < condensation silicones<addition silicones
c. condensation silicones <polysulfides < polyethers < addition silicones
d. condensation silicones < polysulfides < addition silicones < polyethers

Answer D.

1. Non-Elastic
    a. Compound
    b. Zinc oxide eugenol
    c. Impression plaster
2. Elastic
    a. Hydrocolloids
        i. Agar hydrocolloid
        ii. Alginate hydrocolloid
    b. Elastomeric materials
        i. Polysulfide rubber-excellent tear strength, good surface detail, multiple pours
        ii. Silicone rubber
            1. Condensation-no longer used
            2. Addition-(PVS) accurate, multiple pours, good for undercuts
        iii. Polyether rubber-very accurate, rigid, hydrophilic, multiple pours

Property	Polysulfide	Addition silicone	polyether
Working time	Mod Long	Short to Mod	Short
Setting Time	Mod Long	Short to Mod	Short
Shrinkage on setting	Mod High	Very Low	Low
Permanent deformation in compression	Mod High	Very Low	Mod High
Flexibility During removal	High	Low to Mod	Low
Tear Strength	Mod High	Moderate	Low
Flow after setting under small forces	Mod High	Very Low	Very Low
Wettability by Gypsum	Moderate	Poor to Good	Good
Detail Reproduction	Excellent	Excellent	Excellent

Powers J.M, and Sakaguchi RL, Craig's Restorative Dental Materials, 12 edition

241. Which of the following modes of failure is not associated with non-rigid (fiber) posts?

A. Decementation of post and core from the tooth
B. Leakage / open margins
C. Catastrophic root fracture
D. Recurrent caries

ANSWER: **C.** Catastrophic root fracture

Posts made of nonstiff materials (low modulus of elasticity) are more resilient, absorb more impact force, and transmit less force to the root than stiff posts. However, low modulus posts fail at lower levels of force than high modulus posts. A bent, broken, or structurally weakened post then displaces the core and crown. Excessive flexing of the post and micromovement of the core are particularly a risk in teeth with minimal remaining tooth structure because these teeth lack their own cervical stiffness as a result of the missing dentin. Post flexion can also distort and open crown margins. Open margins can result in potentially devastating caries or endodontic leakage and apical reinfection. Extensive caries extending into the root can be as irreparable as root fracture.

The primary benefit of resilient posts with a lower modulus of elasticity is protection of the root from fracture through reduction of the transfer of forces through the post to the root. This post flexibility is beneficial for teeth with more than 3 to 4 mm of remaining axial dentin, which provides cervical stiffness to the tooth/post/core complex. Numerous in vitro studies of posts report that teeth restored with nonrigid posts have fewer catastrophic, irreparable root fractures when tested to failure. In extracted teeth restored with carbon fiber/composite core or custom cast post/core and a cast crown, the fiber post/core failed at a lower load but failed without root fracture. The cast post/core did not fail until loads were reached that rarely occur clinically, but it failed with fracture of the tooth. A significantly higher rate of root fracture was found in teeth restored with stiffer zirconium posts than in quartz fiber or carbon fiber posts. Clinical studies of fiber post systems also report successful multiyear service with few or no root fractures. A retrospective clinical study of carbon fiber posts and custom cast posts reported root fractures in 9% of teeth restored with cast posts, and no root fractures in teeth restored with fiber posts after 4 years. The primary mode of failure has been reported to be decementation of the post from the root.

Cohen, Stephen C. Cohen. Pathways of the Pulp, 9th Edition. C.V. Mosby, 2006.

242. Which of the following is not true concerning restoring the endodontically treated tooth?

A. Placing a small groove in the path of placement of a post in an extensively damaged tooth increases rotational resistance
B. Stresses are increased as post length increases
C. Custom made posts are advantageous in canals with noncircular cross sections or in canals with extreme taper
D. The thickness of remaining dentin is the prime variable in fracture resistance of the root

Answer: B. Stresses are increased as post length increases

6 key features of successful design for a post and core are:

1. Adequate apical seal
2. Minimum canal enlargement (no undercuts)
3. Adequate post length
4. Positive horizontal stop (to minimize wedging)
5. Vertical wall to prevent rotation (similar to a box)
6. Extension of the final restoration margin onto sound tooth structure

Excessive enlargement of the canal can perforate or weaken the root resulting in a split root. The thickness of remaining dentin is the prime variable in fracture resistance of the root. Photoelastic stress analysis also has shown that internal stresses are reduced with thinner posts. The amount of coronal tooth structure remaining is probably the most important predictor of clinical success. If more than 2mm of coronal tooth remains, the post design probably has a limited role in the fracture resistance of the restored tooth. The ferrule is thought to bind the remaining tooth structure together and preventing root fracture during function.

Studies have shown that as post length increases, so does retention. Short posts are more likely to result in root fracture.

Increasing post diameter in an attempt to increase retention is not recommended. Stresses are reduced as post length increases. A serrated or roughened post is more retentive than a smooth one and controlled grooving of the post and root canal considerably increases retention of a tapered post.

For posterior teeth, 2 or more relatively shorter posts in divergent canals is recommended due to root curvatures and anatomy such as curves and elliptical or ribbon-shaped canals.

Placing a small groove in the path of placement in an extensively damaged tooth increases rotational resistance.

Custom made posts are advantageous in canals with noncircular cross sections or in canals with extreme taper.

Rosenstiel, Land, Fujimoto. Contemporary Fixed Prosthodontics. 4th edition, 2006.

243. Which of the following investment types is matched with the appropriate restoration?

A. Gypsum-bonded investment → MCR crown
B. Quartz-bonded investment →base metal restoration
C. Phosphate-bonded investment → base metal restoration
D. Phosphate-bonded investment → MCR crown

Answer: D. Phosphate-bonded investment → MCR crown

Investments classified by binder:

1. Gypsum-bonded - Gypsum is binder, along w/ crystobalite or quartz as refractory material
2. Phosphate-bonded – high concentration of silica refractory material. Binder consists of magnesium oxide & an ammonium phosphate compound. Most mixed w/ colloidal silica
3. Silica-bonded

Gypsum-bonded investments:

Cristobalite and quartz responsible for thermal expansion of mold during wax elimination. Because gypsum is not chemically stable at temperatures exceeding 1200 F (650 C), these investments are typically restricted to castings of conventional ADA types II, III and IV gold alloys. ***Not used for MCR's*** because gypsum unstable at high temps.

Phosphate bonded-investments:

Because most metal ceramic alloys fuse at 1400 C (2550 F) (gold alloys at 925 C, or 1700 F), additional shrinkage occurs when casting cools to room temperature. To compensate, a larger mold is needed. Added expansion obtained using phosphate-bonded investments.

Material is stable at burnout temps above 650 C (1200 F), allowing for additional thermal expansion. Some phosphate-bonded investments contain carbon and are gray in color. **Carbon-containing materials shouldn't be used for casting base metals because carbon residue affects final alloy composition**. May be used for casting high-gold or palladium content alloys. ***Material of choice for casting metal-ceramic alloys.***

Castings made w/ phosphate-bonded investments are rougher than those made w/ gypsum-bonded investments.

Classifying alloys for intended use:

Type I: simple inlays
Type II: complex inlays
Type III: crowns and fixed prostheses
Type IV: RPD's and pinledges and cast post/cores

*Porcelain-type alloys w/ high noble metal content found to have hardness similar to type III alloys, & base metal alloys found to be harder than type IV alloys

Rosenstiel, Land, Fujimoto. Contemporary Fixed Prosthodontics. 4th edition, 2006.

244. For a gold crown that turns black, all of the following causes/remedies are correct except:

a. The mold remained in the oven too long	normal pickling procedure
b. The wax was not completely eliminated	normal pickling procedure
c. An oxidizing flame was used in melting the alloy	normal pickling procedure
d. The investment did not contain any deoxidizing agents	normal pickling procedure

ANSWER: b. The wax was not completely eliminated normal pickling procedure

Dark castings (black) from incomplete burnout of the wax. The black coating is from carbon particles on the alloy and cannot be removed by pickling.

With calcium sulfate-bonded investments, when the color of a casting is black after removal from the investment, the cause is probably one of the following
1. **The wax was not completely eliminated** – very fine particles of carbon cover the investment pores through which the gas in the mold cavity is supposed to escape. **The black color in this instance cannot be cleansed by routine pickling action because acids are not effective in removing carbon from the surfaces of noble or high-noble alloys**. If the black color of the gold casting is removed by the normal pickling procedure, it was caused mainly by cooper oxides formed during casting. Most casting investments contain some reducing agents to provide a reducing atmosphere when the molten alloys are entering the mold cavity

2. **The mold remained in the oven too long** – if the investment mold is left too long in an oven, all the deoxidizers will be decomposed and eliminated. Thus, when the molten alloy enters the mold cavity, the oxidation of copper is not prevented and the casting will be black.

3. **The oxidizing flame was used in melting the alloy** – if an oxidizing flame is used when melting the alloy, the casting will be black.

4**. The investment did not contain any deoxidizing agents** – Some investments routinely produce blackened castings because the manufactures do not add any deoxidizing agents.

Castings that are black because of oxidation of some of the elements in the alloy can easily be cleaned, and the original alloy color can be restored by normal pickling procedures.

Dark castings (black) from incomplete burnout of the wax. The black coating is from carbon particles on the alloy and cannot be removed by pickling.

Craig's Restorative Dental Materials; 12th edition; pg 433-435

245. Which of the following porcelain components is least abrasiveness to enamel?

A. Alumina
B. Feldspar
C. Lithium Disilicate
D. Leucite

Answer: C. Lithium Disilicate

Brand	***Empress***	***Empress 2***	***Finesse***	***In-Ceram***	***Mark II***	***Procera***	***MCR***
Crystalline phase	Leucite	Lithium Disilicate	Leucite	Alumina	Feldspar	Alumina	Leucite
Strength	Medium	High	Medium	High	Medium	Very high	Very high
Fracture toughness	Medium	High	Medium	High	Medium	Very high	Medium
Enamel abrasiveness	Medium	Low	Medium	High	Medium	Medium	Medium
Marginal fit	Fair	Fair	--	Fair	Fair	Fair	Good

Rosenstiel, Land, Fujimoto, "Contemporary Fixed Prosthodontics", Third edition, Mosby 2001.

246. The following are used for fabrication of provisional restorations except

a. methyl methacrylate
b. transbutyl methacrylate
c. isobutyl methacrylate
d. urethane dimethacrylate

ANSWER: b. transbutyl methacrylate

Commonly used provisional material

Material	**Examples**	**Advantages**	**disadvantages**
Methyl Methacrylate	Jet, alike, Duralay	-Good marginal adaption -Most color stability -Good polishability -Good strength -Esthetic,durable -repairable -Inexpensive	-Highly exothermic -6% shrinkage -Free monomer toxic to tissue -Strong odor
Vinyl Ethyl Methacrylate	Snap, Trim	-good polishability -low exothermic rxn -low shrinkage -good stain resistance -inexpensive	-low surface hardness and wear resistance -low strength,toughness -low durability -marginal color stability -marginal esthetics
Isobutyl methacrylate	Temp Plus	-good polishability -low exothermic rxn -moderate shrinkage -high fracture toughness -high flexibility -inexpensive	-low color stability -poor esthetics
Bis-acryl	Integrity, Maxitemp	-best marginal fit -low exothermic reaction -good abrasion resistance -Acceptable color stability -repairable	-limited shade selection -brittle -limited polishabiity -expensive
Urethane dimethacrylate	Triad	-high surface hardness -good strength -color stability -controllable working time	-brittle -limited shade selection -less stain resistance -low repair strength -expensive

Craig's Restorative Dental Materials 12th edition

247. Which of the following statements represents the correct usage of die spacer?

A. Die Spacer should be 5 µm at the margins and 30 µm everywhere else
B. Die Spacer should be 10 µm at the margins and 50-100 µm everywhere else
C. Is painted 50-75 µm over the entire die, ends on axio-gingival line angle
D. Is painted 10-30 µm over entire die, but ends 1mm short of the finish line

ANSWER: **D.** painted 10-30 µm over entire die, but ends 1mm short of finish line

Fill the restoration half full of disclosing wax and heat it in a flame just enough to make the wax flow and adhere to the inner surface. The tooth must be wet with saliva to keep the wax from sticking to it. When the wax has resolidified, seat the restoration, hold it in place for approximately 10 seconds, and remove it. Areas of metal-tooth contact will appear inside a crown as shiny spots devoid of wax. Ideally, the margins (where no cement spacer was used on the die) should show intimate contact, and the remainder of the restoration should have a thin coating of wax representing the cement space.

Following the impression of the prepared tooth, a master cast with removable dies is constructed. Trim the dies and block out any undercuts. Apply cement spacer to the dies, staying 0.5 to 1.0 mm from the finish line.

Shillingburg, H.. Fundamentals of Fixed Prosthodontics, 3rd Edition. Quintessence Publishing (IL), 011997.

Some laboratories will coat the die with a die spacer on stone dies to allow space for the cement in the final restoration. The spacer is brushed onto the die as a viscous liquid, then allowed to dry before applying wax lubricant and wax. The thickness of the spacer, which can be difficult to control, ranges from 10 to 30 µm and is a function of the manipulative technique. Die spacers should not be used to compensate for improper manipulation of the other materials in the casting process, nor should they be used on the margins of the restoration.

Posterior crowns are often cast in base-metal alloys but, because of their high melting temperatures, phosphate investments are almost always used. Also, as a result of their high freezing temperatures, more shrinkage of the alloy must be compensated for than in gold-based alloys to obtain accurately fitting castings. The extra compensation can be obtained by (1) painting a die spacer (varnish) on the die, but short of the margins, before preparing the wax pattern; and/or (2) using two layers of ceramic paper liner in the investing ring to make the setting expansion of the investment more effective.

Powers, John M.. Restorative Dental Materials, 11th Edition. C.V. Mosby, 2001.

248. Which of the following statements is true regarding the addition of retentive features in fixed restorations?

A. Boxes and grooves should be placed on mesial and distal walls of crown preparations
B. One groove is as effective as two grooves placed on opposing walls of crown preparations
C. Boxes and grooves should be placed on facial and lingual walls of crown preparations
D. Mesial and distal boxes offset mesial and distal forces placed on preparations for fixed dental prostheses

Answer: A. Boxes and grooves should be placed on mesial and distal walls of crown preparations

In a study by Proussaefs et al (2004) it was found that proximal grooves, proximal boxes, buccolingual grooves, occlusal inclined planes, and occlusal isthmuses were not effective at increasing a crown's resistance to dislodgement when the tooth preparation lacked resistance. The only crown modification that offered enhanced resistance form when compared with the control group was the reduced TOC in the cervical half of the axial wall.

Proussaefs P, Campagni W, Bernal G, Goodacre C, Kim J. The effectiveness of auxiliary features on a tooth preparation with inadequate resistance form. J Prosthet Dent. 2004 Jan;91(1):33-41.

In a 2008 study by Lu and Wilson, it was shown that the addition of one groove did not affect the dislodgment values, but addition of two grooves caused a highly significant increase in resistance.

Lu PC, Wilson P. Effect of auxiliary grooves on molar crown preparations lacking resistance form: a laboratory study. J Prosthodont. 2008 Feb;17(2):85-91.

Boxes and grooves are the most common forms of auxiliary resistance.
-for crowns, the mesial and distal surfaces have less convergence than facial and lingual surfaces. Here, it is suggested that boxes and grooves be placed on the mesial and distal surfaces to enhance their effectiveness.
-in FPDs, mesial and distal boxes will offset buccal and lingual forces—especially if the pontics are located facial to the rotation axis. If the span length is long, facial and lingual grooves will offset mesial and distal movement.

249. Which porcelain to metal bonding phenomenon makes the ceramic less sensitive to tensile stress induced by mechanical loading?

a. Chemical Bonding
b. Mechanical Interlocking
c. Residual Stresses
d. Metal wetting and contact angle

ANSWER: c. Residual Stresses

The formation of strong chemical bonding – An interface between a metal and a ceramic with many strong chemical bonds between them, with the bonds acting as tags that hold the two materials together, would obviously lead to strong bonding. However, methods producing a ceramic-metal interface with strong chemical bonding have not been developed. The formation of oxides on the surface of the metal has been proved to contribute to the formation of strong bonding.

Mechanical interlocking between the two materials – from both theoretical and practical standpoints, the roughness of a ceramic-metal interface has a large effect on adhesion. The ceramic penetrating into a rough metal surface can mechanically interlock with the metal, like Velcro, improving adhesion. Airborne particle abrasion is often used to remove excess oxide and to roughen the surface of the metal coping to improve the bonding of the ceramic.

Residual stresses – High residual stresses between the metal and ceramic can lead to failure. If the metal and ceramic have different thermal expansion coefficients, the two materials will contract at different rates during cooling and strong residual stresses will form across the interface. Most porcelain has coefficients of thermal expansion between 13 and 14 X 10-6 degrees Celsius and metals between 13.5-14.5 X 10-6 degrees Celsius. **The difference of 0.5 X 10-6 degrees Celsius in thermal expansion between the metal and ceramic causes the metal to contract slightly more than does the ceramic during cooling after firing. This condition puts the ceramic under slight residual compression, which makes it less sensitive to tensile stress induced by mechanical loading**

Craig's Restorative Dental Materials, Powers et al, 12th edition

250. Which series of terms describes the Captek system for fabricating MCRs.

a. Increased metal substructure thickness/Excellent esthetics/Excellent marginal adaptation
b. Reduced metal substructure thickness/Excellent esthetics/Excellent marginal adaptation
c. Reduced metal substructure thickness/Excellent esthetics/Questionable marginal adaptation
d. Reduced metal substructure thickness/Questionable esthetics/Questionable marginal adaptation

ANSWER b. Reduced metal substructure thickness/Excellent esthetics/Excellent marginal adaptation

In the Captek system the coping is produced from two metal-impregnated wax sheets that are adapted to a die and fired. The first sheet forms a porous gold-platinum-palladium layer that is impregnated with 97% gold when the second sheet is fired. **Advantages of the system include excellent esthetics and marginal adaptation.**

Fig. 25-15. The Captek system. **A,** Duplicated refractory die. **B,** Trimming the metal-impregnated wax sheet. **C,** Adapting first sheet to the die. **D,** First layer is fired to form a porous coping. **E,** Adapting second metal-impregnated wax sheet. **F,** Fired framework. **G,** Sectioned Captek crown showing coping design. *Continued*

Note: Capillary action draws the 2nd sheet of gold into the porous substructure during the 2nd firing.

Rosenstiel et al; Contemporary Fixed Prosthodontics; 3rd edition, 2001

251. All of the following are advantages of a partial gold restoration over ceramic restorations except:

A. burnishability and malleability of margins
B. no need for divergent wall preparation
C. better marginal adaptation
D. less abrasion of the opposing enamel

Answer: B. no need for divergent wall preparation

- Cast gold restorations have characteristics include low restoration wear; low wear of opposing teeth; lack of breakage; burnishability and malleability; and proven long term service
- Bonding cast gold restorations with resin cement improves their characteristics even more
- Tooth-colored inlays and onlays, both ceramic and filled polymer, are increasing in use, and their serviceability is acceptable at a moderate level, cast gold restorations remain the standard of care for long-term indirect restorative service
- Two negative aspects of cast gold restorations can be minimized by current technology: 1- degeneration of traditional cement at margins and 2- weakening of teeth caused by cutting divergent inlay tooth preparations.
- Seating cast gold inlays-onlays with insoluble resin cement over acid-etched, bonded tooth preparations reduces or nearly eliminates cement degeneration and can increase the strength of tooth preparations by bonding cusps together

GJ Christensen, "The coming demise of cast gold restorations?" Journal of Am Dent Assoc, 1996; 127; 1233-1236

252. Biomechanical consideration dictates conventional placement of a stress-breaker on a long span FDP with the:

a. male component on the distal of the pier abutment
b. female component in the mesial of the pier abutment
c. female component in the distal of the pier abutment
d. male component on the mesial of the pier abutment

Answer. C

Stress breakers: any connector that permits limited movement between otherwise independent members of a fixed dental prosthesis

Indications:

1. intermediate pier abutments
2. mobile teeth which need to be splinted together with a fixed prosthesis
3. misaligned abutments where parallel preparation might result in devitalization
4. long-span FDPs which can distort due to shrinkage and pull of the porcelain on thin sections of the framework
5. a questionable distal abutment exists and fabrication of a RPD is considered to be the next step

Biomechanical considerations:

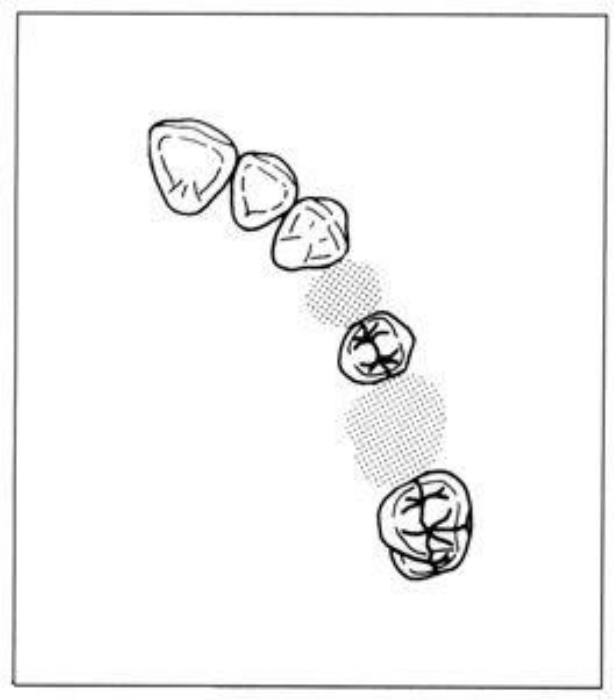
- **Conventional orientation**
  - female component is in the distal of the pier abutment
    - prevents unseating action
    - easier to fabricate
    - if distal abutment fails, can still maintain the mesial abutment
    - Avoids overtapering abutments to gain a common path of insertion
    - Overpreparation of the mesial abutment may be required to accommodate the matrix
    - May be more difficult to obtain an optimal esthetic result
    - Requires at least 3mm of height

- **non-conventional orientation-reverse orientation(upside down)**
    - male component in mesial of pier abutment
        - more esthetic result than conventional
        - less tooth reduction to accommodate connector
        - Lab fall back in case there are 2 paths of draw
        - May create adverse forces on the mesial abutment due to cantilever effect
        - May not have enough height for the connector and the porcelain

Rosenstiel et al; Contemporary Fixed Prosthodontics; 3rd edition, 2001

253. Which of the following statements is false concerning the pier abutment in the diagram?

A. If the keyway of a non-rigid connector was on the distal of the pier abutment, mesial movement, due to occlusal forces, seats the key into the keyway more solidly.
B. If the keyway of a non-rigid connector was on the distal of the pier abutment, the anterior units of a non-rigid FPD may supraerupt if unopposed.
C. If restored with a rigid FPD, forces transmitted to the terminal would cause the prosthesis to bend rather than rock.
D. If restored with a rigid FPD, intrusion of the abutments under the loading could lead to failure between any retainer and its respective abutment.



ANSWER: **B.** If the keyway of a non-rigid connector was on the distal of the pier abutment, the anterior units of a non-rigid FPD may supraerupt if unopposed.

Rigid connector FPD: It has been theorized that forces are transmitted to the terminal retainers (of a as a result of the middle abutment acting as a fulcrum, causing failure of the weaker retainer. However, photoelastic stress analysis and displacement measurement indicate that the prosthesis bends rather than rocks. Intrusion of the abutments under the loading could lead to failure between any retainer and its respective abutment.

Nonrigid connector FPD: The nonrigid connector is a broken-stress mechanical union of retainer and pontic, instead of the usual rigid connector. The keyway of the connector should be placed within the normal distal contours of the pier abutment, and the key should be placed on the mesial side of the distal pontic. The long axes of the posterior teeth usually lean slightly in a mesial direction, and vertically applied occlusal forces produce further movement in this direction. If the keyway of the connector is placed on the distal side of the pier abutment, mesial movement seats the key into the keyway more solidly. Placement of the keyway on the mesial side, however, causes the key to be unseated during its mesial movements. If the posterior abutment and pontic are either unopposed or opposed by a removable partial denture and if the three anterior units are opposed by natural teeth, the key and the posterior units that are subjected to little or no occlusal forces may supererupt.

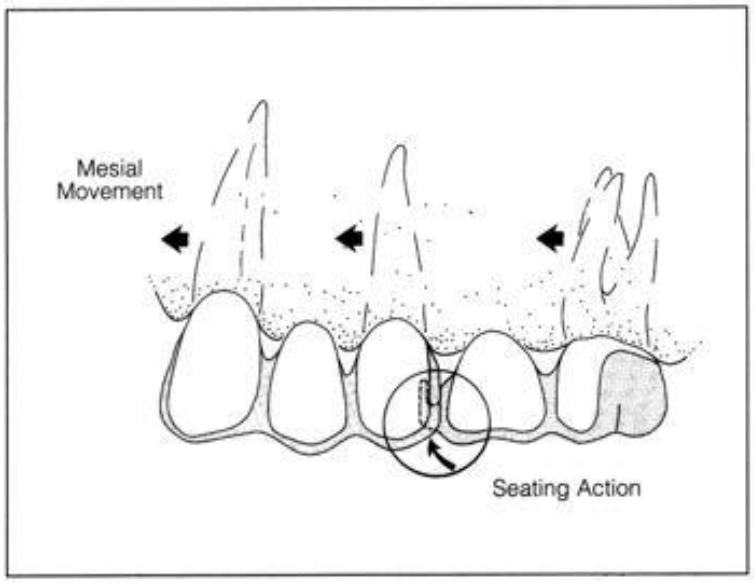


Fig 7-24 If a nonrigid connector is placed on the distal side of the retainer on a middle abutment, movement in a mesial direction will seat the key into the keyway.

Shillingburg, H. *Fundamentals of Fixed Prosthodontics, 3rd Edition*. Quintessence Publishing (IL), 1997.

254. Which of the following statements is incorrect regarding arcon and nonarcon semi-adjustable articulators?

A. The condylar spheres are attached to the lower component of the arcon articulator
B. The angulation of the mechanical fossae of the arcon articulator is fixed in relation to the occlusal plane of the maxillary cast
C. The mechanical fossae of the nonarcon articulator are attached to the upper member
D. The angle formed by the maxillary occlusal plane and the condylar inclination changes on opening with the nonarcon articulator.

Answer C: The mechanical fossae of the nonarcon articulator are attached to the upper member

Arcon - (articulator and condyle) - condylar spheres attached to lower component of articulator and mechanical fossae are attached to upper member. Thus, the arcon articulator is anatomically 'correct'. Angulation of mechanical fossae is fixed in relation to occlusal plane of maxillary cast.

Non-arcon - Angulation of mechanical fossae is fixed tin relation to occlusal plane of mandibular cast

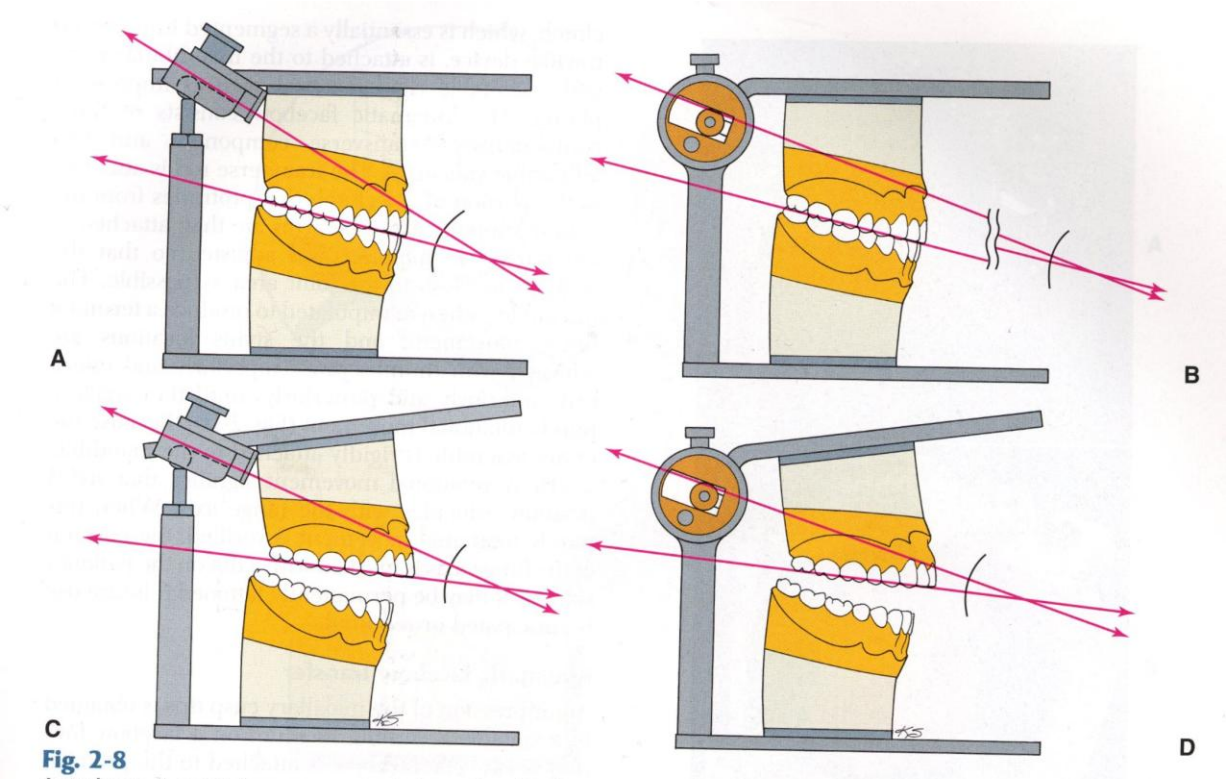


Fig. 2-8
Articulators. **A** and **C** show an arcon articulator; **B** and **D** show a nonarcon articulator. An advantage of the arcon design is that the condylar inclination of the mechanical fossae is at a fixed angle to the maxillary occlusal plane. With the nonarcon design, the angle changes as the articulator is opened, which can lead to errors when a protrusive record is being used to program the articulator.
(Redrawn from Shillingburg HT, et al: Fundamentals of Fixed Prosthodontics, 2nd ed. Chicago, Quintessence Publishing, 1981.)

Rosenstiel, Land, Fujimoto. Contemporary Fixed Prosthodontics. 4th edition, 2006.

255. Which one of the aspects of the Hanau's quint cannot be controlled by the clinician?

A. Incisal guidance
B. Condylar guidance
C. Occlusal plane
D. Compensating curve

Answer: B. Condylar guidance

Hanau's Quint

1. CG Condylar guidance *fixed and determined by patient's TMJ anatomy*
2. IG Incisal guidance *can be controlled by clinician*
3. CC Compensation curve *can be controlled by clinician*
4. CH Cuspal height *can be controlled by clinician*
5. OP Occlusal plane *can be controlled by clinician*

Theilman's Formula

$$\textit{Balanced occlusion} = \frac{\mathbf{CG} \times \mathbf{IG}}{\mathbf{CH} \times \mathbf{CC} \times \mathbf{OP}}$$

NOVA Dental, complete denture course - HAMADA, RT432A, http://www.docstoc.com/docs/33696919/Complete-Denture-Occlusion-Lecture-Handout

256. Which terms describe the purpose of an arbitrary facebow and its accompanying degree of error?

a. Record and transfer the maxillary relationship to an arbitrary axis on the articulator with a minimum of 5 mm of error
b. Record and transfer the mandibular relationship to an arbitrary axis on the articulator with a minimum of 11mm of error
c. Record and transfer both the maxillary and mandibular relationship to an arbitrary axis on the articulator with a minimum of 5 mm of error
d. Record and transfer the maxillary relationship to an arbitrary axis on the articulator with a minimum of 11 mm of error

ANSWER A

Facebows are used to record the anteroposterior and mediolateral position of the maxillary occlusal surfaces relative to the transverse opening and closing axis of the patient's mandible. Then the facebow is used to transfer the recorded relationship of the maxilla by ensuring the corresponding cast is attached in the correct position relative to the hinge axis of the articulator.

Arbitrary hinge axis facebows approximate the horizontal transverse axis and rely on anatomic averages. They give sufficiently accurate relationship for most diagnostic and restorative procedures. However, regardless of which arbitrary position is chosen, a minimum error of 5mm from the axis can be expected.

Rosenstiel et al; Contemporary Fixed Prosthodontics; 3rd edition, 2001 pg 33